

Reference range of full blood count in blood donors

We performed a prospective study on 652 consecutive donors, before and at the end of a standard blood donation, to determine post donation CBC reference ranges and to evaluate the modifications of CBC values induced by blood donation. A significant decrease of all CBC values, excepting MCV, was found.

For many years now we have used post-donation blood samples to determine full blood count (FBC) values in blood donors. These values are used to determine the general health conditions of the donors, the suitability for and the interval to next donation, with particular attention to early detection of donor anemia. The FBC is evaluated by comparing post-donation values with population reference ranges. In a previous study we observed that post-donation hemoglobin (Hb) levels, determined by an automatic cell counter, were significantly lower than pre-donation Hb levels, determined by HemoCue on a fingerprick sample.^{1,2} This difference was suggestive of an early change of Hb concentration induced by blood donation. However, the different types of samples and methods used to determine Hb concentration did not allow definition of whether the difference was true or was due to methodological problems. More recently, Vuk *et al.*³ found a statistically significant difference in venous Hb levels between pre- and post-donation samples in a very small group of donors. In view of the existing information, we performed a prospective study in a large group of consecutive donors attending our Center. The primary aim of this study was to determine an appropriate post-donation reference range for the FBC. The secondary end-point was to collect an accurate estimate of the modifications occurring in FBC values between pre- and post-donation samples.

To this aim we determined the FBC by a Sysmex NE8000 cell counter (TOA, Japan) on venous samples collected in K3EDTA from 652 consecutive donors before and at the end of a standard blood donation (450±45 mL). All donors were eligible for donation and had pre-donation Hb values exceeding the minimum acceptable levels (>12.5 g/dL for women, >13.5 for men, as required by the Italian law). From these data, we determined post-donation FBC reference ranges (5th- 95th centile) (Table 1). We observed a statistically significant decrease (*p* < 0.001, *t* test) in all parameters of the FBC, except the mean corpuscular volume (MCV), in both sexes (Table 2). The differences between mean Hb values (±SE) in females and in males were 0.87±0.02 g/dL and 0.7±0.02 g/dL, respectively.

The findings of Fogh-Andersen *et al.*⁴ offer a clue to the interpretation of our results. These investigators tested 26 blood donors

Table 1. Reference ranges (5th -95th centile) for post-donation FBC in donors grouped by sex.

	Females (n=287)		Males (n=370)	
	Min	Max	Min	Max
Hemoglobin (g/dL)	11.7-	14.4	13.2-	15.9
Hematocrit (%)	34.4-	41.8	38.5-	45.8
Red blood cells (× 10 ⁹ /mL)	3.86-	4.79	4.37-	5.37
MCV (fL)	82-	94	81-	93
White blood cells (× 10 ⁹ /L)	4.02-	8.16	3.85-	8.49
Platelets (× 10 ⁹ /L)	177-	319	153-	296
Neutrophils (× 10 ⁹ /L)	2.18-	5.58	2.09-	5.97
Eosinophils (× 10 ⁹ /L)	0.03-	0.22	0.04-	0.3
Basophils (× 10 ⁹ /L)	0.01-	0.07	0.02-	0.08
Lymphocytes (× 10 ⁹ /L)	1.13-	2.51	1.07-	2.54
Monocytes (× 10 ⁹ /L)	0.13-	0.45	0.13-	0.48

Table 2. Pre- and post-donation FBC values (mean±SD) and their difference (mean±SE).

	Females (n=287)			Males (n=370)		
	Pre	Post	Difference	Pre	Post	Difference
Hemoglobin (g/dL)	13.7±0.8	12.8±0.8	0.87±0.02	15.3±0.8	14.6±0.8	0.70±0.02
Hematocrit (%)	40.8±2.2	37.7±2.2	3.05±0.09	44.7±2.4	42.1±2.2	2.49±0.09
RBC (×10 ⁹ /mL)	4.57±0.31	4.26±0.3	0.29±0.01	5.08±0.32	4.85±0.32	0.23±0.01
MCV (fL)	89±0.25	88±0.23	0.92±0.11	88±0.22	87±0.22	0.94±0.07
Plts (× 10 ⁹ /L)	265±50	245±45	18.9±0.98	231±49	218±47	12.2±0.77
WBC (× 10 ⁹ /L)	7.06±1.51	5.83±1.31	1.20±0.03	6.86±1.64	5.70±1.44	1.21±0.02
Neu. (× 10 ⁹ /L)	4.24±1.20	3.67±1.06	0.53±0.02	3.95±1.27	3.48±1.18	0.49±0.03
Eos. (× 10 ⁹ /L)	0.13±0.1	0.09±0.08	0.03±0.001	0.16±0.11	0.13±0.09	0.03±0.002
Bas. (× 10 ⁹ /L)	0.03±0.02	0.03±0.01	0.004±0.001	0.04±0.02	0.03±0.01	0.002±0.001
Lymph. (× 10 ⁹ /L)	2.30±0.54	1.76±0.43	0.54±0.01	2.30±0.57	1.76±0.43	0.54±0.01
Mono. (× 10 ⁹ /L)	0.34±0.11	0.25±0.10	0.08±0.006	0.36±0.12	0.26±0.10	0.09±0.005

Abbreviations: RBC: red blood cells; MCV: mean corpuscular volume; Plts.: platelets; WBC: white blood cells; Neu.: neutrophils; Eos.: eosinophils; Bas.: basophils; Lymph.: lymphocytes; Mono.: monocytes.

and found that 36% of the donated blood was replaced by interstitial fluid during blood donation. The occurrence of hemodilution during blood donation requires proper management of post-donation FBC values if these are used to evaluate donors with early onset of anemia and their eligibility for next donation. In our series, post-donation Hb values were lower than the minimum levels acceptable in almost 25% of women and 10% of men.

In conclusion, our study defines of a specific reference range of post-donation FBC values that will be prospectively used for the evaluation of blood parameters in our blood donor population. We suggest that transfusion services using post-donation samples to check donor hematologic conditions should determine their local reference range of post-donation FBC values. This may become unnecessary if closed-circuit systems for the collection of samples from the blood collection tube connecting needle to bag become routinely available, so that donor hematologic conditions can be evaluated from pre-donation blood samples.

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